Increasing System Reliability Through Repairing the S Phase Hotspot Clamp in Circuit Breaker in The Reactor Bay of the Nagan Raya Substation

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ABSTRACT
Electrical installation equipment is always exposed to factors that cause its condition to deteriorate, such as physical/mechanical, chemical and environmental contact. The factor used as a reference for inspection is the temperature of the operational equipment. Unnatural temperatures will be produced by electrical equipment because electricity is energy that produces heat and worsens the condition of the equipment, so infrared cameras play a role in monitoring the condition of electrical equipment using the temperature of the equipment as a reference. The Thermovision method is a remote monitoring of the temperature conditions of substation equipment when under load to determine the hot temperature of the clamps and conductors and the difference between the two. This journal discusses the repair of hot spots found in the reactor bay Circuit Breaker equipment at the Nagan Raya Main Substation with a temperature of 85.3°C. Temperature standards in determining equipment condition are in accordance with SPLN SK DIR/No.520/2014. Thus, the results of measurements using conductor thermovision in the reactor bay can be used as a reference for preparing further maintenance recommendations.

Keywords: Substation, Maintenance, Thermovisi, Hot Spot, Temperature Standard

Introduction

Nagan Raya Main Substation is one of the main substations located at PT PLN (Persero) UPT Banda Aceh which is included in ULTG Meulaboh. The main substation is a connecting node in the electric power system, which consists of an arrangement and series of equipment installed in a location. Specifically, for receiving and distributing electric power, increasing and decreasing the voltage according to the working voltage level, a place to carry out circuit switching work in an electric power system and to support the reliability of the electric power system.

Hot spots in substation equipment are a parameter that is frequently monitored and analyzed for changes over time. This is closely related to the security and reliability of the system at the main substation itself. The conductor is a very important part. Clamps connect equipment to each other passing through conductors as current and voltage transition. If the temperature in the clamp is very hot, it will have a negative impact on the conductor which over time will cause the conductor to break because it is no longer strong enough to withstand the heat. Not only that, the clamp will also cause fires or hot spots to appear around the clamp, of course. This resulted in losses by PLN due to this anomaly because the power transformer could not transmit power.

Anomalies that cause hotspots that often occur are caused by loose connection clamps, rusty bolts, connection clamps that have reduced quality, so this needs to be followed up as soon as possible. For this reason, routine measurements are needed as early detection of hotspot anomalies by carrying out in Service Measurement / Level 2 Inspection (thermovision) when the equipment is under load.

Research Methodology

The research method used was data measurements carried out by the substation operator on all equipment at the Nagan Raya PT PLN (Persero) ULTG Meulaboh substation with the aim of obtaining equipment temperature data. With the background that has been explained, problems can be identified and steps can be determined to achieve the desired goals. The problem that occurred was that several hotspot points were found on the connection clamps on the substation equipment. Hot spots or hotspots are a phenomenon that occurs in equipment that is powered by current in substation equipment. Hotspots are caused by several factors including:

1. Load, there is a change in load, which at first is small, but then the load gets bigger.
2. Decreased quality of equipment, the use period or age of the equipment is too long so it needs to be replaced or repaired.
3. Final Check Quality. During the final check, we were not careful enough to check the installed accessories.
4. Material, dirty clamp, corrosion and tightness of bolt nuts.

The initial method for detecting hotspots is by periodically measuring the temperature with a thermovision tool. Errors in collecting data during thermovision measurements can result in the actual condition of the hotspot not being detected, thereby risking disruption to the electricity distribution, causing interruptions in the electricity supply to customers.

The function of monitoring in the implementation of themovisi is to find potential or hotspot seeds that arise so that they can be followed up immediately, so that emergency blackouts do not occur. Determining the occurrence of a hotspot using 2 comparisons, namely clamp connections with conductors and clamp connections between phases.

Based on the manual for Serandang and substation grounding, the comparison of temperature results (Δt) and recommendations for thermovision measurement results are grouped into 3 (three) categories, namely:

Table 1. Table of Condition Categories for Differences in Measurement Results

CATEGORY	MEASURING RESULTS (Δt)	CONDITION
I	<5°C	Initial overheating condition
II	5-30°C	Increased overheating
III	>30°C	Acute overheating

Table 2. Table of Recommendations for Thermovision Measurement Results

COMPONENT	MEASURING RESULTS (Δt)	RECOMMENDATION
➢ Solid insulation (isolator) ➢ Conductor Wire ➢ Compression joint ➢ Jumper ➢ Conductor clamps	I (<5°C)	Continue regular measurements every 6 months
	II (5-30°C)	Scheduled repair or replacement within a maximum of 1 month
	III (>30°C)	Repair or replace as soon as possible within 1 week

Thermovision measurements are carried out by substation officers when carrying out substation CBM work (Condition Base Maintenance). Some thermovision tools that are often used are FLIR.

This thermovision tool will observe the heat distribution that occurs on an object and visualize it through gradations / color scales which usually use infrared media. Excessive temperature on an object will produce significant color gradations when compared to the temperature of the objects around it. From the picture below you can see the results of thermovision measurements on the Clamp in PMT phase S Bay Reactor at Nagan Raya Substation.

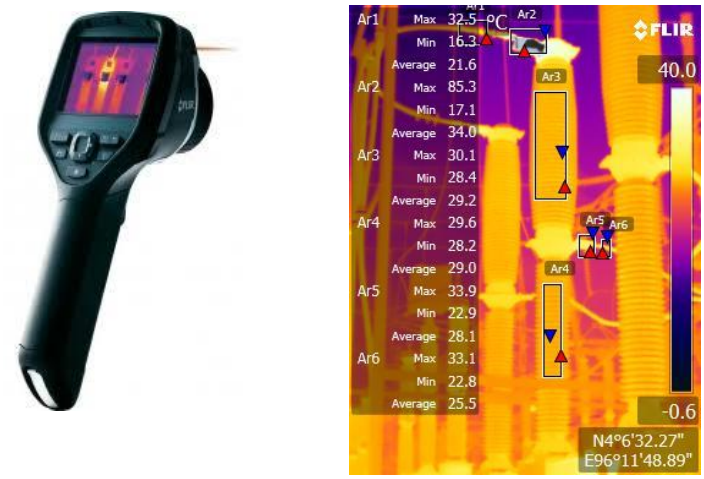

Figure 1. FLIR Themovision

Results

Thermovision measurements carried out routinely by substation officers will provide the latest temperature data for each installed MTU equipment. This data is used as a reference to see whether the temperature conditions of the equipment are still normal or not.

As we know, hotspots are caused by many factors, namely dirty, loose clamp connections, hotspot detection not being optimal, the quality of the materials used, overload or corrosion. Here are the solutions that I can explain to repair hotspot anomalies.

1. Clamp connection is dirty
   Clean the connection clamps and conductors first as well as the MTU equipment. Once clean, smear contact grease on the surface of the connection clamp and conductor.
2. Loose/loose bolts
   The use of Spring Rings on bolts is mandatory as a tool to compensate for changes in bolt tightness during conductor expansion losses caused by loading on the distribution or on moving MTU equipment (example: PMS). If the bolt is not tight enough, the clamp connection will be loose and become a potential source of hotspots, whereas if it is too tight it can damage the clamp. For this reason, it is recommended to use a Torque Wrench to tighten this tightening so that the tightening is more measured so that the results obtained are optimal.
3. Rust/Corrosion
   Cleaning is carried out by sanding or brushing the rusty part of the connection clamp first. If the connection clamp is still rusty then the clamp must be replaced with a new one with material that has the ability to resist rust/corrosion.

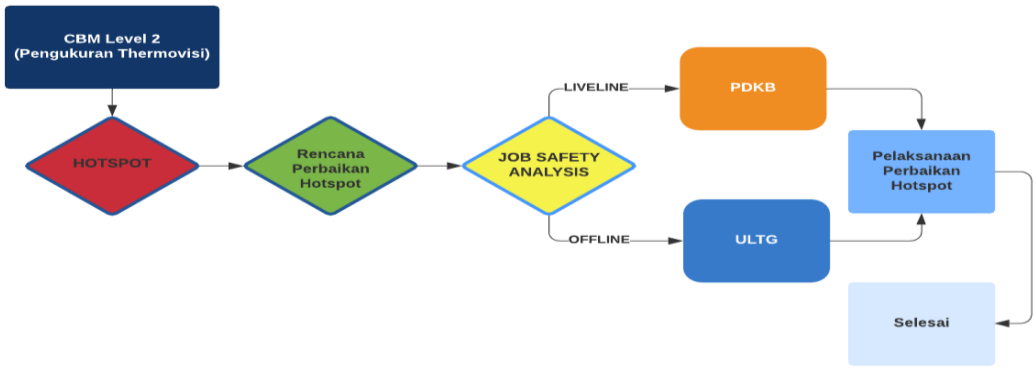

Figure 2. Flowchart for Hotspot Management

Thermovision before repairing the Clamp in PMT Phase S Bay Reactor

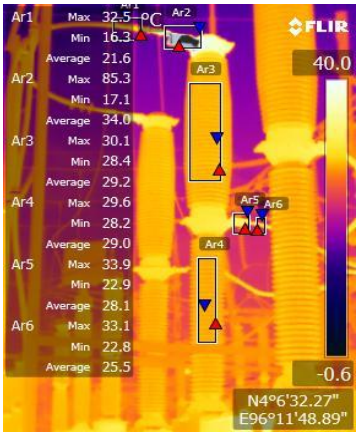

Figure 3. Thermovision before repair

Based on the thermovision and visual results carried out by the GI Operator where the S phase shows a higher temperature than the other phases, this has indicated recommendations from the thermovision measurement results that improvements will be made.
Hotspot Clamp Repair Process in S Bay Reactor at Nagan Raya GI Reactor:

A. Work equipment and materials used in the work
    1. Personal Protective Equipment (PPE)
        a. Helmet
        b. Full Body Harnest
        c. Safety Shoes
        d. Gloves
        e. Anti-glare glasses
    2. Work Tools
        a. Toolsets
        b. Gerindra
    3. Materials
        a. 19" Nuts and Bolts
        b. Sand Paper
        c. Spanjard

B. Sequence of Work

1. Process of relieving voltage in GI Nagan Raya Reactor Bay (Maneuver by Substation Operator)

Figure 4. Safety Briefing before work

2. Installation of Grounding in Reactor Bay
3. Open the Clamp In PMT Phase S

Figure 5. on-the-job documentation

Figure 6. Discovery of Dirty Clamps and Rusty Bolts

a. Cleaning Clamp and Replacing bolts
b. Reinstall the clamp
c. The repair process is complete
d. Carry out the normalization process for the Meulaboh GI Reactor Bay (Maneuver by the Substation Operator)

4. Thermovision after repair of Clamp in PMT Phase S Bay Reactor

The thermovision results after repair were 36.1 ℃

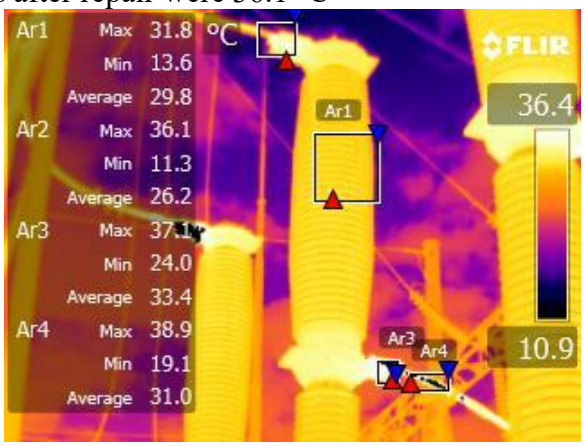

Figure 7. Thermovision after repair

Conclusion

From the description of the paper above, several conclusions are obtained as follows:

1. Installation reliability is getting better.
2. Categories of differences in temperature measurement results (Δt) after thermovision, as follows:

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